PATENT SPECIFICATION

596,102

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PROVISIONAL SPECIFICATION

A New Magnesium Base Alloy

I, RUPERT MARTIN BRADBURY, "The Uplands", 57, Windley Crescent, Darley Abbey, Derby, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to magnesium base alloys, and has for its object to provide an alloy having excellent creep strength particularly at temperatures of about 130 to 300 degree Centigrade together with good casting qualities, corrosion resistance, and freedom from microporosity.

According to the invention I make an alloy containing the following elements within the following ranges,

Aluminium	3.0	to 11.0	per cent.
Calcium	0.15	to 1.25	per cent.
Tin	0.25	to 4.00	per cent.
Manganese	0.01	to 1.00	per cent.
Silicon	0.0	to 0.30	per cent.
Iron	0.0	to 0.20	per cent.

Magnesium the remainder.

Other elements which go into solid solution in magnesium, namely cerium, bismuth, cadmium, gallium, lanthanum, lithium lead, thallium, silver, zinc, zirconium, may be present up to a total of 1.5 per cent.

The cerium if present may be replaced by the so-called "Cerium mischmetall".

The elements copper, nickel, beryllium, cobalt, antimony, boron, chromium, niobium, molybdenum, tantalum, thorium, tellurium, titanium, tungsten, vanadium, sodium, barium whether present as minor constituents or as impurities should not exceed a total of 0.5 per cent.

This alloy is particularly suitable for sand and die castings but it can be forged, extruded, pressed or rolled.

The castings can be used in the "as cast" state or in the stabilised condition, which stabilising treatment can be carried out at temperatures up to about 350 degrees Centigrade. However the alloy is amenable to the usual solution and ageing treatments.

An example of a preferred composition for a sand casting alloy had the following composition,

Aluminium	6.2 per cent.
Calcium	0.60 per cent.
Tin	2.00 per cent.
Manganese	0.18 per cent.

Magnesium the remainder.

A one inch diameter sand mould test bar was cast and after a stabilising treatment at 275 degrees Centigrade the following properties were obtained,

Ultimate Stress	14.2 tons per square inch.
Elongation	6.0 per cent.
Brinell Hardness	63

If the aluminium content is raised to 8.0 per cent. the other constituents calcium, tin, and manganese remaining the same as in the example given, a slightly better casting alloy results but the tensile properties are somewhat lower, the ultimate stress being 12.2 tons per square inch and the elongation 4.2 per cent. and the Brinell hardness 66.

The creep strength, that is that tensile stress which can be permanently sustained without fracture, is more than 33 per cent. higher than for such standard alloys as D.T.D. 59, D.T.D. 136, D.T.D. 281, D.T.D. 289, at temperatures of 150 degrees centigrade and over.

The improved corrosion resistance of this alloy is shown by the fact that the loss in weight in immersion in saline water at room temperatures is less than 50 per cent. of the loss of D.T.D. 59, and D.T.D. 136, and only about 10 per cent. of the loss of D.T.D. 281, and D.T.D. 289.

All magnesium casting alloys are liable to patches of micro-porosity, which results,

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in very considerabl reduction in strength in the areas. This alloy is as free from this defect as any magnesium casting alloy known to me and by proper casting technique this trouble can be eliminated.

A preferred composition for working, including pressing, forging, extruding, composed of

Aluminium	4.5 per cent.
Calcium	0.5 per cent.
Tin	1.75 per cent.
Manganese	0.10 per cent.
Cerium	0.10 per cent.

Magnesium the remainder,

has the following properties in the pressed condition,

Ultimate Stress	19.0 to 22.0 tons per square inch.
0.1 per cent. Proof Stress	14.0 to 15.0 tons per square inch.
Elongation	9.0 to 13.0 per cent.

The alloy is compounded according to commercial practice.

Dated this 18th day of July, 1945.
RUPERT MARTIN BRADBURY.

COMPLETE SPECIFICATION

A New Magnesium Base Alloy

I, RUPERT MARTIN BRADBURY, "The Uplands", 57, Windley Crescent, Darley Abbey. Derby, a British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to magnesium base alloys and has for its object to provide an alloy having excellent creep strength particularly at temperatures of about 130 degrees Centrigrade to 300 degrees Centigrade together with good casting qualities, corrosion resistance and freedom from micro-porosity.

According to the invention I make an alloy within the following ranges,

Aluminium	3.00 to 11.00 per cent.
Calcium	0.15 to 1.25 per cent.
Tin	0.25 to 4.00 per cent.
Manganese	0.01 to 1.00 per cent.
Silican	0.00 to 0.30 per cent.
Iron	0.00 to 0.20 per cent.

Magnesium the remainder.

One or more other elements which go into solid solution in magnesium namely, cerium, bismuth, cadmium, gallium, lanthanum, lithium, lead, thallium, silver, zinc, zirconium, may be present up to a total of 1.50 per cent. The cerium if present may be added in the form of the so-called "Mischmetall".

The alloy may contain one or more of the elements copper, nickel, beryllium, cobalt, antimony, boron, chromium, niobium, molybdenum, tantalum, thorium, tellurium, titanium, tungsten, vanadium, sodium, and barium, but these elements whether present as minor constituents or as impurities should not exceed a total of 0.50 per cent. and the antimony will always be below 0.10 per cent. Small quantities of copper are generally present in magnesium possessing a high degree of purity.

The purer the magnesium, used, the more corrosion resistant is the final alloy.

All proportions quoted are percentages of the whole by weight.

The expression "Magnesium the remainder", is not intended to exclude the usual traces of impurities or of elements used in the normal refining processes of the alloy. The non-metallic impurities generally contained in electrolytically produced magnesium are chlorides, nitrides and oxides. Phosphorus may also be present in minute traces.

The alloy is compounded according to commercial practice. The magnesium is first melted under the usual magnesium flux, and to the melt are added alloys of magnesium rich in one or two of the elements to be added. Certain of the elements such as calcium and tin, may be added in the solid form to the melt containing the other elements.

This alloy is particularly suitable for sand and die castings but it can be forged, extruded, pressed or rolled.

The castings can be used in the "as cast" state or in the stabilised condition, which stabilising treatment can be carried out at temperatures preferably between 250 degrees Centigrade and 350 degrees Centigrade. However, the alloy is amenable to the usual solution and natural or artificial ageing treatments.

EXAMPLE 1.

A preferred composition for a sand casting alloy had the following composition.

Aluminium	6.20 per cent.
Calcium	0.60 per cent.
Tin	2.00 per cent.
Manganese	0.18 per cent.

Magnesium the remainder.

A one inch diameter sand mould test bar was cast and after a stabilising treatment at 275 degrees Centigrade the following properties were obtained,

Ultimate Stress	14.2 ton per square inch.
Elongation	6.0 per cent.
Brinell Hardness	63

If the aluminium content is raised to 8.00 per cent. the other constituents, calcium, tin and manganese remaining the same as in the example given, a slightly better casting alloy results but the tensile properties are somewhat lower, the ultimate stress being 12.00 tons per square inch, and the elongation 4.20 per cent. and the brinell hardness 66.

The creep strength, that is, that tensile stress which can be permanently sustained without fracture, is more than 33 per cent. higher than for such standard alloys as D.T.D. 59, D.T.D. 136, D.T.D. 281, and D.T.D. 289, at temperatures of 150 degrees Centigrade and over.

The improved corrosion resistance of this alloy is shown by the fact that the loss in weight on immersion in saline water at room temperatures is less than 50 per cent. of the loss of D.T.D. 59, D.T.D. 136, and only about 10 per cent. of the loss of D.T.D. 281 and D.T.D. 289.

All magnesium casting alloys are liable to patches of micro-porosity which result in very considerable reduction in strength in these areas. This alloy is as free from this defect as any magnesium casting alloy known to me and by proper casting technique this trouble can be eliminated.

EXAMPLE 2.

A preferred composition for working (including pressing, forging, extruding), composed of,

Aluminium	4.50 per cent.
Calcium	0.50 per cent.
Tin	1.75 per cent.
Manganese	0.10 per cent.
Cerium	0.10 per cent.

Magnesium the remainder.

has the following properties in the pressed condition.

Ultimate Stress	19.0 to 22.0 tons per square inch.
0.1% Proof Stress	14.0 to 15.0 tons per square inch.
Elongation	9.0 to 13.0 per cent.

EXAMPLE 3.

A sand cast test bar of the following composition,

Aluminium	8.00 per cent.
Calcium	0.55 per cent.
Tin	1.90 per cent.
Manganese	0.22 per cent.
Cerium	0.02 per cent.

Magnesium the remainder.

was solution treated for 24 hours at 430 degrees Centigrade and cooled in air, followed by ageing at 200 degrees Centigrade for 4 hours.

The tensile properties were,

Maximum Stress	18.3 tons per square inch.
Elongation	7.2 per cent.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A magnesium alloy composed of the following elements in the following proportions.

Aluminium	3.00 to 11.00 per cent.
Calcium	0.15 to 1.25 per cent.
Tin	0.25 to 4.00 per cent.
Manganese	0.01 to 1.00 per cent.

Magnesium the remainder.

2. A magnesium alloy as claimed in Claim No. 1, containing silicon not

Al 3~11
Ca 0.15~1.25
Sn 0.25~4
Mn 0.01~1.0

exceeding 0.30 per cent.

3. A magnesium alloy according to Claims No. 1 or 2, containing iron not exceeding 0.20 per cent.

4. A magnesium alloy according to any of the preceding claims containing one or more of the elements, cerium, bismuth, cadmium, gallium, lanthanum, lithium lead, thallium, silver, zinc, zirconium, not exceeding 1.50 per cent. in total.

5. A magnesium alloy according to any of the preceding claims containing one or more of the elements copper, nickel, beryllium, cobalt, antimony, boron, chromium, niobium, molybdenum, tantalum, thorium, tellurium, titanium, tungsten, vanadium, sodium, barium, not exceeding 0.50 per cent. in total, the antimony always being below 0.10 per cent.

6. A magnesium alloy according to any of the preceding claims in the sand cast, die cast or worked condition.

7. A magnesium alloy according to Claim No. 6, which has been subjected to a stabilising treatment, carried out at temperatures preferably between 250 degrees Centigrade and 350 degrees Centigrade.

8. A magnesium alloy according to Claim No. 6, which has been solution treated followed by natural or artificial ageing.

9. A magnesium alloy as herein described.

Dated the 10th day of June, 1946.

RUPERT MARTIN BRADBURY.

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